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# PATENT ABSTRACTS OF JAPAN

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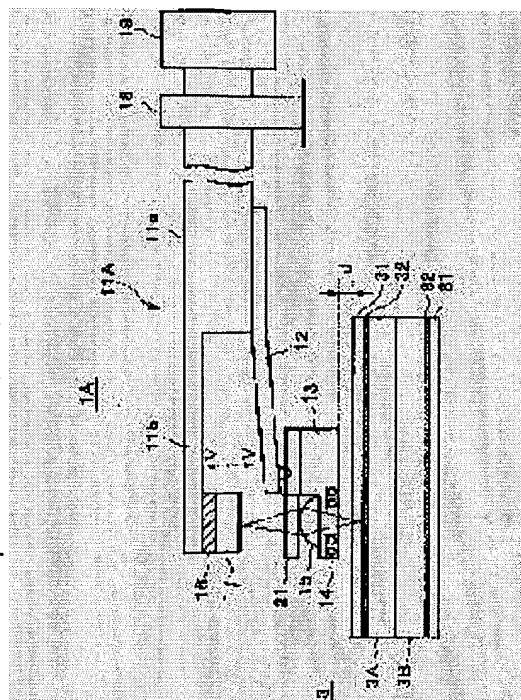
## (54) OPTICAL HEAD DEVICE AND OPTICAL RECORDING/REPRODUCING DEVICE

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To correct the wave front aberration of an optical system in a flying head and further preferably to suppress the fluctuation in the floating height of the head.

**SOLUTION:** In the magneto-optical head device 1 utilizing the flying head, an objective lens 15 is mounted on a slider 13. For correcting the wave front aberration, a liquid crystal panel 21 changing the refractive index in accordance with the impressed voltage is arranged between the objective lens 15 and an optical part 17 having a laser diode, a beam splitter and a photodetector 173. The liquid crystal panel 21 annularly divided in the radial state is preferable for exactly correcting the wave front aberration. Further preferably, a piezoelectric

element 16 is mounted on an arm 11A and the optical part 17 is fixed thereon. The piezoelectric element 16 is displaced by making the voltage impressed on the piezoelectric element 16 to change in accordance with the fluctuation in the floating height of the slider 13, thereby the position of the optical part 17 is changed. Thus, the optical path length is changed and the fluctuation in the floating height of the slider 13 is substantially adjusted.



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**CLAIMS**


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[Claim(s)]

[Claim 1] The writing of the data to an optical rotation record medium, and/ Or the arm which is optical head equipment which reads optically and was supported to revolve free [ rotation ], The suspension where the end was fixed to the inferior surface of tongue of the above-mentioned arm and where elasticity is, The slider with which an end is fixed to the free end of the above-mentioned suspension, it separates from said arm, and only a predetermined distance surfaces from the field of said optical rotation record medium according to the atmospheric pressure accompanying rotation of said optical rotation record medium, The objective lens carried in the above-mentioned slider so that the above-mentioned optical rotation record medium might be countered, Optical head equipment possessing the wave aberration amendment means established at least between the optical department which has a luminescence means, a beam splitter means, and a light-receiving means, and with which the above-mentioned arm was equipped, and the above-mentioned optical department and the above-mentioned objective lens.

[Claim 2] The above-mentioned wave aberration means is optical head equipment according to claim 1 which has optical equipment from which a refractive index changes.

[Claim 3] The optical equipment from which the above-mentioned refractive index changes is optical head equipment according to claim 2 which has the liquid crystal panel from which a refractive index changes according to applied voltage.

[Claim 4] It is optical head equipment according to claim 3 which the above-mentioned liquid-crystal control means computes the signal which amends wave aberration based on the servo signal computed from the signal detected with the light-receiving means of the above-mentioned optical department, and is sent out to the above-mentioned liquid-crystal driving means by the above-mentioned wave aberration amendment means having further the liquid crystal control means carried in the above-mentioned optical department, respectively, and the liquid-crystal driving means which impresses driver voltage to the above-mentioned liquid crystal panel.

[Claim 5] The above-mentioned liquid crystal panel is optical head equipment according to claim 3 which is divided and constituted by the shape of a concentric circle in two or more ring domains, and is constituted so that a refractive index can be changed according to the electrical potential difference impressed the whole ring domain.

[Claim 6] The liquid crystal control means by which the above-mentioned wave aberration amendment means was carried in the above-mentioned optical department, respectively, It has further the liquid crystal driving means which impresses driver voltage independently to each field of the above-mentioned liquid crystal panel. The above-mentioned liquid crystal control means Optical head equipment according to claim 5 which computes the signal which amends the wave aberration for every field of the above-mentioned liquid crystal panel based on the servo signal computed from the signal detected with the light-receiving means of the above-mentioned optical department, and is sent out to the above-mentioned liquid crystal driving means.

[Claim 7] Optical head equipment according to claim 1 with which the above-mentioned arm is

equipped and which has further the optical-path-length adjustment actuator which adjusts substantially the optical path length of the optical path from the above-mentioned optical department of the optical head equipment concerned to the above-mentioned objective lens.

[Claim 8] It is optical head equipment according to claim 7 which is the actuator which said arm is equipped with said optical department so that it may point to the direction where the field of said optical rotation record medium and an optical axis cross at right angles, and carries out a variation rate so that said optical-path-length adjustment actuator may be moved in the direction which intersects the above-mentioned optical department perpendicularly with the field of said optical rotation record medium.

[Claim 9] It is optical head equipment according to claim 7 which is the actuator which said arm is equipped with said optical department so that it may point to the direction in which an optical axis is parallel to the field of said optical rotation record medium, and carries out a variation rate so that the above-mentioned optical-path-length adjustment actuator may be moved in the direction which is parallel to the field of said optical rotation record medium in the above-mentioned optical department.

[Claim 10] The above-mentioned actuator is optical head equipment according to claim 8 which is a piezo-electric element.

[Claim 11] the above-mentioned actuator -- electromagnetism -- the optical head equipment according to claim 8 which is an actuator.

[Claim 12] The above-mentioned actuator is optical head equipment according to claim 9 which is a piezo-electric element.

[Claim 13] the above-mentioned actuator -- electromagnetism -- the optical head equipment according to claim 9 which is an actuator.

[Claim 14] Said optical rotation record medium is optical head equipment according to claim 1 with which it is the optical rotation record medium of the method with which the writing of data is performed in a field impression condition or a field modulation condition, and said objective lens and the magnetic impression means, or the field modulation means is carried in said slider.

[Claim 15] Said optical rotation record medium is optical head equipment according to claim 1 with which it is the optical rotation record medium of the method with which reading of data is performed in the state of a non-field, and only said objective lens is carried in said slider.

[Claim 16] The writing of the data to an optical rotation record medium and said optical rotation record medium, and/ The optical head equipment which reads optically, and said optical head equipment are driven. Or writing of the data to said optical rotation record medium and/ They are the optical recording and the regenerative apparatus which has the control unit which reads data. Or the above-mentioned optical head equipment The arm supported to revolve free [ rotation ] and the pendant member in which the elasticity fixed to the inferior surface of tongue of the above-mentioned arm has an end, The \*\* slider with which an end is fixed to the free end of the above-mentioned pendant member, it hangs from the above-mentioned arm, and a predetermined distance surfaces from the field of the above-mentioned optical rotation record medium according to change of the atmospheric pressure accompanying rotation of the above-mentioned optical rotation record medium, So that it may have a luminescence means, a beam splitter means, and a light-receiving means and may be in agreement with the objective lens carried in the above-mentioned slider at least at the optical axis of the above-mentioned objective lens with which the optical axis of these optical means was carried in the above-mentioned slider They are the optical recording and the regenerative apparatus which possesses the wave aberration amendment means established between the optical department with which the above-mentioned arm was equipped, and the above-mentioned optical department and the above-mentioned objective lens, and has the tracking servo control means which said control device drives said arm drive actuator, and performs truck position control.

[Claim 17] The above-mentioned wave aberration means is the optical recording and a regenerative apparatus according to claim 16 which has optical equipment from which a refractive index changes.

[Claim 18] The optical equipment from which the above-mentioned refractive index changes is the optical recording and a regenerative apparatus according to claim 17 which has the liquid crystal panel from which a refractive index changes according to applied voltage.

[Claim 19] They are the optical recording and the regenerative apparatus according to claim 18 which the above-mentioned liquid crystal control means computes the signal which amends wave aberration based on the servo signal computed from the signal detected with the light-receiving means of the above-mentioned optical department, and is sent out to the above-mentioned liquid crystal driving means by the above-mentioned wave aberration amendment means having further the liquid crystal control means carried in the above-mentioned optical department, and the liquid crystal driving means which impresses driver voltage to the above-mentioned liquid crystal panel, respectively.

[Claim 20] The above-mentioned liquid crystal panel is the optical recording and a regenerative apparatus according to claim 18 which is divided and constituted by the shape of a concentric circle in two or more ring domains, and is constituted so that a refractive index can be changed according to the electrical potential difference impressed the whole ring domain.

[Claim 21] They are the optical recording and the regenerative apparatus according to claim 20 which the above-mentioned liquid-crystal control means computes the signal which amends the wave aberration for every field of the above-mentioned liquid crystal panel based on the servo signal computed from the signal detected with the light-receiving means of the above-mentioned optical department, and sends out to the above-mentioned liquid-crystal driving means by the above-mentioned wave-aberration amendment means having further the liquid-crystal control means carried in the above-mentioned optical department, and the liquid-crystal driving means which impresses driver voltage independently to each field of the above-mentioned liquid crystal panel, respectively.

[Claim 22] They are the optical recording and the regenerative apparatus according to claim 16 which has the optical-path-length adjustment means who the above-mentioned control device drives said optical-path-length adjustment actuator, and adjusts the optical path length of the optical system in said optical head equipment, and \*\*\*\*\* by equipping the above-mentioned arm with the above-mentioned optical head equipment, and having further the optical-path-length adjustment actuator which adjusts substantially the optical path length of the optical head equipment concerned.

[Claim 23] They are the optical recording and the regenerative apparatus according to claim 22 which is the actuator which said arm is equipped with said optical department so that it may point to the direction where the field of said optical rotation record medium and an optical axis cross at right angles, and carries out a variation rate so that said optical-path-length adjustment actuator may be moved in the direction which intersects the above-mentioned optical department perpendicularly with the field of said optical rotation record medium.

[Claim 24] They are the optical recording and the regenerative apparatus according to claim 22 which is the actuator which said arm is equipped with said optical department so that it may point to the direction in which an optical axis is parallel to the field of said optical rotation record medium, and carries out a variation rate so that the above-mentioned optical-path-length adjustment actuator may be moved in the direction which is parallel to the field of said optical rotation record medium in the above-mentioned optical department.

[Claim 25] The above-mentioned actuator is the optical recording and a regenerative apparatus according to claim 23 which is a piezo-electric element.

[Claim 26] the above-mentioned actuator -- electromagnetism -- the optical recording and the regenerative apparatus according to claim 23 which is an actuator.

[Claim 27] The above-mentioned actuator is the optical recording and a regenerative apparatus according to claim 24 which is a piezo-electric element.

[Claim 28] the above-mentioned actuator -- electromagnetism -- the optical recording and the regenerative apparatus according to claim 24 which is an actuator.

[Claim 29] Said optical rotation record medium is the optical recording and a regenerative apparatus according to claim 16 with which it is the optical rotation record medium of the method with which the writing of data is performed in a field impression condition or a field modulation condition, and said objective lens and the magnetic impression means, or the field modulation means is carried in said slider.

[Claim 30] Said optical rotation record medium is the optical recording and a regenerative apparatus

according to claim 16 with which it is the optical rotation record medium of the method with which reading of data is performed in the state of a non-field, and only said objective lens is carried in said slider.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical head equipment of a flying head mold, and the optical recording and the regenerative apparatus using it especially about optical recording and regenerative apparatus, such as an optical disk record regenerative apparatus and a magneto-optic-disk record regenerative apparatus, and the optical head equipment used for optical recording and a regenerative apparatus. Specifically, this invention relates to the optical head equipment, and the optical recording and the regenerative apparatus which amend wave aberration using a liquid crystal device etc. Moreover, in addition to wave aberration, this invention relates to the optical head equipment which amends the flying height of a flying head further and performs more exact focal control, and the optical recording and the regenerative apparatus using it.

[0002]

[Description of the Prior Art] Optical head equipment was divided into a fixed part and moving part, and only predetermined distance surfaced moving part from optical rotation record media, such as a magneto-optic disk. "the optical disk head of a RAINGU head mold is put in practical use.

[0003] Drawing 18 is drawing illustrating "optical magnetic head of flying head mold" 220 which a head part is surfaced as 1st conventional technique of the optical magnetic head of a flying head mold using the wind pressure resulting from rotation of a magneto-optic disk 210, and secures a predetermined distance in the direction of a focus.

[0004] The optical magnetic head 220 has the optical block 221, 1 shaft actuator 222, a voice coil motor 223, a galvanomirror 224, and the over-writing magnetic head 225 carried in 1 shaft actuator 222 in order to read the writing of the data to the magneto-optic disks 210, such as MD which rotates with a spindle motor 215, and the data from a magneto-optic disk 210.

[0005] The laser diode, the beam splitter, the photodetector, etc. are constituted in one by the optical block 221. However, the objective lens is prepared in the point of the head near the over-writing magnetic head 225, and is separated in the optical block 221.

[0006] 1 shaft actuator 222 is moved in the one direction by the voice coil motor 223. Tracking control of the optical MAG pickup 220 is performed by a voice coil motor 223 and the galvanomirror 224. Focal control is performed by 1 shaft actuator 222. A focal distance is maintained when only a gap predetermined [ the field of a magneto-optic disk 210 to ] in the over-writing magnetic head 225 surfaces with the wind pressure accompanying rotation of a magneto-optic disk 210.

[0007] The beam light by which outgoing radiation was carried out from the laser diode within the optical block 221 passes a beam splitter, and is led to the objective lens which is deflected with a galvanomirror 224 and located at the tip of a head. An objective lens converges beam light and irradiates the recording surface of a magneto-optic disk 210. Incidence is carried out to a beam splitter, and the return light from which the reflected light from a magneto-optic disk 210 was deflected with the galvanomirror 224 toward the galvanomirror 224 through the objective lens is deflected by the beam splitter, and carries out incidence to a photodetector. A photodetector is for example, a quadrisection

detector.

[0008] In the optical MAG pickup 220, the optical system and the objective lens of the optical block 221 are optically connected through a galvanomirror 224. Thus, since only the flying head is carried out to the objective lens containing 1 shaft actuator, and the 45-degree mirror in moving part, there is an advantage that moving part becomes small.

[0009] However, the structure of the optical MAG pickup 220 of driving 1 shaft actuator 222 with a voice coil motor 223 is complicated, and the dimension of the optical MAG pickup 220 is still large. Furthermore, since the optical path from the optical block 221 to an objective lens is too long, optical dependability is low, and the further miniaturization is difficult and it is difficult to make it a low price. Then, although the optical recording "multilayered" (multi-plate) and the regenerative apparatus which accumulated the magneto-optic disk 210 of such complicated structure in accordance with two or more sheet same revolving shaft are tried in order to attain large capacity-ization, it is difficult to apply the optical MAG pickup mentioned above to such equipment as a matter of fact.

[0010] Drawing 19 is the block diagram of the optical magnetic-head equipment as 2nd conventional technique of the optical magnetic head of a flying head mold. The optical magnetic-head equipment 320 illustrated to drawing 19 is optical magnetic-head equipment of the flying head mold which TeraStor has proposed. This optical magnetic-head equipment performs writing of data, and read-out of data to the magneto-optic disks 310, such as MD which rotates with a spindle motor (not shown). Optical magnetic-head equipment 320 Therefore, the swing jazz arm 321, The optical magnetic head 322 of the flying head mold with which one edge of an arm 321 was equipped, The objective lens 327 carried in the optical magnetic head 322, and a field modulation coil (not shown), It has the 1st mirror 323 prepared in the upper part of the optical magnetic head 322, the 2nd mirror 324 prepared in the arm 321, the voice coil motor 325 which is made to rotate an arm 321 horizontally and performs tracking control, and the light source module 326.

[0011] The light source module 326 has a laser diode, a beam splitter, a photodetector, etc. A photodetector is for example, a quadrisection detector. The objective lens 327 is carried in the optical magnetic head 322, and is separated in the light source module 326.

[0012] The 2nd mirror 324 and 1st mirror 323 are led to the objective lens 327 in which the light beam from the laser diode in the light source module 326 was carried by the optical magnetic head 322. That is, the beam light injected from the laser diode in the light source module 326 passes along a beam splitter, and is deflected towards the 1st mirror 323 by the 2nd mirror 324. The light which carried out incidence is turned to an objective lens 327, and the 1st mirror 323 deflects it. An objective lens 327 completes the light by which incidence was carried out, and is made to irradiate the recording surface of a magneto-optic disk 310. The reflected light from a magneto-optic disk 310 passes along the objective lens 327 carried in the optical magnetic head 322, it is a path contrary to the above, and it passes the 2nd mirror 324 from the 1st mirror 323, goes into the beam splitter in the light source module 326, and results in a photodetector.

[0013] The tracking control of the optical magnetic head 322 drives a voice coil motor 325, makes an arm 321 shake in the predetermined include-angle range horizontally (field parallel to the field of a magneto-optic disk), and is performed. Only a distance required to access the optical magnetic head 322 by the wind pressure accompanying rotation of a magneto-optic disk 310 surfaces from the field of a magneto-optic disk 310. Therefore, focal control is unnecessary.

[0014] Since the 1st mirror 323 or 2nd mirror 324 drives with a micro-actuator, there is an advantage that the two-step tracking control of a coarse adjustment and jogging becomes easy with the swing jazz arm 321.

[0015] However, there is a problem enumerated below.

(1) Since an arm 321 and the light source module 326 are united and move at the time of approaching space (near-field) record actuation, the optical magnetic head 320 has disadvantageous profit that the inertial mass when moving an arm 321 becomes large, and the seek time becomes long. In addition, the voice coil motor 325 which outputs quite big power will be used. These results, the dimension of equipment becomes large, low-pricing is difficult and there is a limitation in a miniaturization.

(2) Since it is carried in the optical magnetic head 322 to which the 1st mirror 323 surfaces according to rotation of a magneto-optic disk 310 in addition to the objective lens 327 and the field modulation coil, the mass of the optical magnetic head 322 becomes large, and sufficient flying height may not be obtained.

(3) Since the optical path between the 1st mirror 323 and the 2nd mirror 324 has opened this optical magnetic head 320 wide, the dependability of the light which disturbance light may advance and spreads this optical path is not guaranteed. It replaces with the 1st mirror 323 and 2nd mirror 324, and although how to use a plane-of-polarization preservation mold optical fiber is also considered, deterioration of a signal quality poses a problem in that case.

As for this optical magnetic head 320, the dimension of equipment is not suitable for the multi-plate-ized magneto-optic recording "multilayered" the magneto-optic disk since it was large, and a regenerative apparatus. [ which was accumulated in accordance with two or more sheet same revolving shaft ]

[0016] Drawing 20 is the block diagram of the optical magnetic-head equipment as 3rd conventional technique of the optical magnetic head of a flying head mold. The optical magnetic-head equipment 420 illustrated to drawing 20 is optical magnetic-head equipment of the flying head mold which QUINTA has proposed.

[0017] The gimbal 422 formed by the elastic member in which this optical magnetic-head equipment has the flexibility fixed at the tip of an arm 421 and an arm 421, The slider 423 which is fixed at the tip of a gimbal 422 and carries out predetermined distance surfacing from a magneto-optic disk 410, It has the optical fiber 428 arranged between the optical system 426 arranged between the objective lens 424 carried in the slider 423, the electrostatic mirror 425, and the electrostatic mirror 425 and an objective lens 424, the optical block 427, the optical block 427, and the electrostatic mirror 425. The optical block 427 has a laser diode, a beam splitter, a photodetector, etc. A photodetector is for example, a quadrisection detector.

[0018] A beam splitter is passed, incidence is carried out to an optical fiber 428, the inside of an optical fiber 428 is spread, the electrostatic mirror 425 irradiates, and it deviates by the electrostatic mirror 425, and passes along optical system 426, incidence is carried out to an objective lens 424, it converges with an objective lens 424, and the beam light by which outgoing radiation was carried out from the laser diode within the optical block 427 is irradiated by the recording surface of a magneto-optic disk 410. The reflected light from a magneto-optic disk 410 passes along an optical path contrary to the above, and it carries out incidence to the beam splitter within the optical block 427, and it is deflected by the beam splitter and carries out incidence to a photodetector.

[0019] In the tracking control of the optical magnetic head 420, by actuators, such as a voice coil motor which is not illustrated, an arm 421 also uses the electrostatic mirror 425 and is positioned on the predetermined truck of a magneto-optic disk 410 while it moves in the predetermined (it is to space) include-angle range in the field of a magneto-optic disk, and a parallel field. In addition, by the wind pressure accompanying rotation of a magneto-optic disk 410, since only a predetermined distance surfaces from a magneto-optic disk 410, as for a slider 423, only a predetermined distance separates an objective lens 424 from a magneto-optic disk 410. Therefore, focal control is unnecessary.

[0020] However, since the optical fiber 428 is being used for the optical magnetic head 420 illustrated to drawing 20, an optical fiber 428 becomes a load to rotation actuation of an arm 421, and it has the problem of reducing the rotation operating characteristic of an arm 421. Furthermore, since optical coupling is performed by the optical fiber 428 and the electrostatic mirror 425, there is disadvantageous profit that optical coupling effectiveness (coupling effectiveness) becomes low. In addition, in the optical magnetic head 420, since a push pull signal cannot be taken, a sample servo fake colander is not obtained for tracking control.

[0021] In optical recording and a regenerative apparatus, short-wavelength-izing and high numerical-aperture(NA)-ization are progressing. For example, although the conventional NA had about 0.5, at a far field place (FFR), there is an about [ NA=1.4 ] thing at NA=0.9 and a near-field place (NFR) recently. It is necessary to set the focal margin in such a situation to \*\*10nm - about \*\*20nm in \*\*0.158

micrometers and NFR in FFR, and there are few focal margins to conventional one and focal margin\*\*1micrometer. However, if it is made the optical magnetic-head structure of a flying head mold, such a focal margin is also theoretically securable. However, in practice, the thing in NFR for which \*\*10nm - about \*\*20nm of precision is maintained, and an objective lens is attached in the optical magnetic head of a flying head mold is difficult, and encounters the problem of installation precision. Furthermore, the installation location of an objective lens may shift by the temperature change and change of humidity. It is also difficult to secure such a location gap by adhesion.

[0022] it is proposed by JP,7-65383,A as an approach of conquering such a problem -- as -- as the optical magnetic head of a flying head mold -- electromagnetism -- the structure which prepared the objective lens which attached the actuator -- carrying out -- mainly -- electromagnetism -- the approach of justifying with an actuator and eliminating a part for DC focus is learned.

[0023] Moreover, as other approaches, a relay lens is arranged to an optical fixed part, and the approach of eliminating a part for DC focus by the relay lens is mainly learned, for example as proposed by JP,7-57284,A.

[0024]

[Problem(s) to be Solved by the Invention] The flying head proposed by JP,7-65383,A has the problem that the dimension of a flying head becomes large. If the dimension of a flying head becomes large, a good premature start (surfacing) property cannot be attained, but a price will also become high.

[0025] The flying head proposed by JP,7-57284,A also has the problem that a dimension becomes large. A good premature start (surfacing) property cannot be attained, but it will become same highly describing a price above, if the dimension of a flying head becomes large.

[0026] The optical recording and the regenerative apparatus using a small optical head applicable to the miniaturization of the latest magneto-optic-recording medium, approaching space (near-field) record, etc. and its optical head are demanded. Furthermore, increase of storage capacity is desired. Although the magneto-optic recording "multilayered" (formation of a multi-plate) and the regenerative apparatus which accumulated the magneto-optic disk etc. in accordance with two or more sheet same revolving shaft as the one approach are demanded, optical heads, such as the optical magnetic head which suits such a multi-plate-ized magneto-optic recording and a regenerative apparatus, and optical MAG pickup, are demanded. In accordance with the revolving shaft of the motor made to rotate a magneto-optic disk, carrying out flying head measles proposed by JP,7-57284,A, the optical-axis disk of two or more sheets is accumulated, and it is small and it difficult to realize the so-called "multilayering (or formation of multi-plate) optical recording and regenerative apparatus aiming at increase of memory capacity.

[0027] It is necessary to eliminate the effect of wave aberration from a viewpoint which performs more exact focal control in a flying head. In addition, wave aberration can be mostly considered to be DC component.

[0028] Also in a flying head, changing the flying height of a slider is known, and in order to perform more exact focal control, it is desirable to amend fluctuation of such the flying height. Since the frequency is high, fluctuation of such the flying height can be considered to be AC component.

[0029] As mentioned above, although the optical magnetic head or the optical MAG pickup used for a magneto-optic disk as a conventional technique was described, also in \*\*\*\*\* which performs signal read-out, the same problem as the above is encountered only with the lightwave signal.

[0030] The purpose of this invention is to offer the optical magnetic head of the small and lightweight flying head mold which can amend wave aberration.

[0031] Other purposes of this invention are to offer the optical magnetic head of the small and lightweight flying head mold which amends the flying height of a head appropriately and can maintain the flying height uniformly in addition to amendment of wave aberration.

[0032] Other purposes of this invention are to offer the reliable small optical head equipment which performs the above and wave aberration amendment which can be used suitable for far field record or near-field record, and/or flying height amendment.

[0033] The purpose of further others of this invention is to offer the optical head equipment which suits multi-plate-ized optical recording and a regenerative apparatus.

[0034] The purpose of further others of this invention is to offer the optical recording and the regenerative apparatus using the optical head equipment mentioned above.

[0035]

[Means for Solving the Problem] According to the 1st viewpoint of this invention, the writing of the data to an optical rotation record medium, and/ Or the arm which is optical head equipment which reads optically and was supported to revolve free [ rotation ], So that an end may counter a suspension with the elasticity fixed to the inferior surface of tongue of the above-mentioned arm, the slider fixed to the free end of the above-mentioned suspension, and the above-mentioned optical rotation record medium The objective lens carried in the above-mentioned slider, and the optical department with which the above-mentioned arm which has a luminescence means, a beam splitter means, and a light-receiving means was equipped at least, The wave aberration amendment means established between the above-mentioned optical department and the above-mentioned objective lens is provided, and the optical head equipment with which only a predetermined distance surfaces from the field of said optical rotation record medium according to the atmospheric pressure accompanying rotation of said optical rotation record medium in the above-mentioned slider is offered.

[0036] By amending wave aberration with a wave aberration amendment means, a more exact field control is realizable.

[0037] The above-mentioned wave aberration means has optical equipment from which a refractive index changes. Change of a refractive index amends wave aberration substantially.

[0038] Preferably, the optical equipment from which the above-mentioned refractive index changes has the liquid crystal panel from which a refractive index changes according to applied voltage. A liquid crystal panel is a penetrable display device applied in various kinds of fields, and can change a refractive index easily according to change of applied voltage.

[0039] Still more preferably, the above-mentioned wave aberration amendment means has further the liquid crystal control means carried in the above-mentioned optical department, respectively, and the liquid crystal driving means which impresses driver voltage to the above-mentioned liquid crystal panel, and the above-mentioned liquid crystal control means computes the signal which amends wave aberration based on the servo signal computed from the signal detected with the light-receiving means of the above-mentioned optical department, and sends it out to the above-mentioned liquid crystal driving means. According to this configuration, amendment of wave aberration is attained with optical head equipment itself.

[0040] Moreover, the above-mentioned liquid crystal panel is preferably divided and constituted by the shape of a concentric circle in two or more ring domains. Preferably, the above-mentioned wave-aberration amendment means has further the liquid-crystal control means carried in the above-mentioned optical department, and the liquid-crystal driving means which impresses driver voltage independently to each field of the above-mentioned liquid crystal panel, respectively, and the above-mentioned liquid-crystal control means computes the signal which amends the wave aberration for every field of the above-mentioned liquid crystal panel based on the servo signal computed from the signal detected with the light-receiving means of the above-mentioned optical department, and sends it out to the above-mentioned liquid-crystal driving means. If a liquid crystal panel is annularly divided and constituted to two or more fields and wave aberration is amended for every field of the, wave aberration can be amended correctly as a whole.

[0041] Still more preferably, the above-mentioned arm is equipped and it has further the optical-path-length adjustment actuator which adjusts substantially the optical path length of the optical path from the above-mentioned optical department of the optical head equipment concerned to the above-mentioned objective lens. If an optical-path-length adjustment actuator is used, since fluctuation of the flying height of a slider can be tuned finely, a field control can be made still more exact.

[0042] Said arm is equipped so that said optical department may point to the direction where the field of said optical rotation record medium and an optical axis cross at right angles, and said optical-path-length adjustment actuator is an actuator to which the variation rate of the above-mentioned optical department is carried out so that it may be made to move in the direction which intersects perpendicularly with the

field of said optical rotation record medium. Or said arm is equipped so that said optical department may point to the direction in which an optical axis is parallel to the field of said optical rotation record medium, and the above-mentioned optical-path-length adjustment actuator is an actuator which carries out a variation rate so that the above-mentioned optical department may be moved in the direction which is parallel to the field of said optical rotation record medium.

[0043] as the above-mentioned actuator -- a piezo-electric element or electromagnetism -- an actuator can be used.

[0044] Said optical rotation record medium is an optical rotation record medium of the method with which the writing of data is performed in a field impression condition or a field modulation condition, and said objective lens and the magnetic impression means, or the field modulation means is carried in said slider. Or said optical rotation record medium is an optical rotation record medium of the method with which reading of data is performed in the state of a non-field, and only said objective lens is carried in said slider.

[0045] According to the 2nd viewpoint of this invention, the optical recording and the regenerative apparatus which has an optical rotation record medium, the optical head equipment which performs optically writing of the data to said optical rotation record medium and/or read-out, and the control unit which drives said optical head equipment and performs writing of the data to said optical rotation record medium and/or read-out of data are offered. Optical head equipment has the configuration of the 1st viewpoint of above-mentioned this invention. The above-mentioned control device has the tracking servo control means which drives said arm drive actuator and performs truck position control.

[0046]

[Embodiment of the Invention] The gestalt of operation of the optical recording and the regenerative apparatus using the optical head equipment and the optical head equipment of this invention is described. Although the optical magnetic head is hereafter described as a gestalt of instantiation-operation of the optical head equipment of this invention, the optical head in this specification is the vocabulary of the large semantics containing the optical magnetic head, an optical head, etc. Similarly, hereafter, although a magneto-optic recording and a regenerative apparatus are described as a gestalt of operation of the optical recording and the regenerative apparatus of this invention, the optical recording and the regenerative apparatus of this invention contain a magneto-optic recording and a regenerative apparatus, optical recording, a regenerative apparatus, etc. In this specification, optical recording and a regenerative apparatus are used in the large semantics meaning either an optical recording device, an optical regenerative apparatus, optical recording and a regenerative apparatus.

[0047] With reference to gestalt drawing 1 of the 1st operation - drawing 7 , the gestalt of the 1st operation of the optical head equipment of this invention, and the optical recording and the regenerative apparatus using it is described. Drawing 1 is the cross-section block diagram of the optical magnetic-head equipment as a gestalt of the 1st operation of the optical head equipment of this invention. Drawing 1 also shows the cross-section configuration of the optical MAG (MO) disk as a gestalt of operation of an optical recording medium. Drawing 2 is the enlarged drawing showing one example of the optical department carried in the optical magnetic-head equipment illustrated to drawing 1 . Drawing 3 is the conceptual diagram showing the configuration of the optical system in the optical head equipment illustrated to drawing 1 . Drawing 4 is a graph which shows the difference of wave aberration with the amendment back before amending wave aberration using the liquid crystal panel illustrated to drawing 1 . Drawing 5 (A) is the basic block diagram of a liquid crystal panel, and drawing 5 (B) is a graph which shows change of the refractive index when impressing an electrical potential difference to the liquid crystal panel illustrated to drawing 5 (A). Drawing 6 (A) is a graph which shows the amendment result of the wave aberration when being the outline block diagram of the liquid crystal panel illustrated to drawing 1 , and changing a refractive index as it is the graph with which drawing 6 (B) is the graph which illustrated the change approach of the refractive index of the liquid crystal panel illustrated to drawing 6 (A), and drawing 6 (C) shows the amount of wave aberration and drawing 6 (D) illustrated the liquid crystal panel illustrated to drawing 7 (A) to drawing 7 (B). Drawing 7 is the block diagram of the control unit which carries out drive control of the optical magnetic-head equipment illustrated to

drawing 1 .

[0048] If the optical magnetic-head equipment illustrated to drawing 1 , an MO disk, the optical department illustrated to drawing 2 , and the control unit illustrated to drawing 8 are combined, it will become the magneto-optic recording and regenerative apparatus of the gestalt of the 1st operation of the optical recording and the regenerative apparatus of this invention.

[0049] The example using MO disk 3 which illustrated the cross section to drawing 1 in the gestalt of this operation as an optical rotation record medium of MO disk this invention is shown. MO disk 3 of drawing 1 is a lamination MO disk which made two MO disks 3A and 3B rival, and record film 32 is formed in the lower part of topcoat 31 in each MO disk 3A and 3B.

[0050] Optical magnetic-head equipment 1 is described with reference to optical magnetic-head equipment drawing 1 . Optical magnetic-head equipment 1 has the arm 11 horizontally rotated with a voice coil motor 19 centering on a shaft 18. Further, an end is fixed to the inferior surface of tongue of an arm 11, and optical magnetic-head equipment 1 has the suspension (pendant member) 12 where the other end is the free end, the slider 13 fixed at the tip of the free end of a suspension 12, the field modulation coil 14 carried in the slider 13, and the objective lens 15 carried in the slider 13 near the field modulation coil 14. Optical magnetic-head equipment 1 has the 45-degree mirror 20 further prepared in the optical department 17 fixed to the top face of an arm 11, and the edge of an arm 11 by inclining 45 degrees in the field of an arm 11. Optical magnetic-head equipment 1 has the liquid crystal panel 21 which amends the wave aberration further prepared in the location which counters with a mirror 20 45 degrees on the inferior surface of tongue of an arm 11. 11h of light transmission holes is formed in the part which was attached in the arm 11 and which a mirror 20 and a liquid crystal panel 21 counter 45 degrees.

[0051] Only the predetermined distance d surfaces from the top face of MO disk 3 with the wind pressure (or an atmospheric pressure and this are also called air bearing) of MO disk 3 which rotates with the spindle motor which does not illustrate a slider 13. That is, optical magnetic-head equipment 1 is optical magnetic-head equipment of a flying head mold (head surfacing mold).

[0052] Thus, since a slider 13 is surfaced by the wind pressure accompanying rotation of MO disk 3, it is necessary to make a slider 13 lightweight as much as possible. Therefore, the 17 or 45 optical department mirror 20 and a liquid crystal panel 21 are carried in an arm 11, and are not carried in a slider 13. Since it is necessary to make an objective lens 15 and the field modulation coil 14 approach MO disk 3, the objective lens 15 and the field modulation coil 14 are carried in the slider 13 close to MO disk 3. As much as possible, the mass of a slider 13, the field modulation coil 14, and an objective lens 15 is small, and it also needs to make a dimension small and a suspension 12 manufactures it in the configuration which manufactures with an ingredient with soft resiliency, or shows resiliency.

[0053] In addition, in this specification, the various optical elements which are not illustrated are named generically the whole optical system of optical magnetic-head equipment 1 to an objective lens 15, the optical department 17, and drawing 1 including the glass layer of the front face of MO disk 3. Therefore, in this specification, optical system does not mean only the optical department 17.

[0054] The configuration of the optical system in the optical magnetic-head equipment illustrated to drawing 1 with reference to drawing 2 and drawing 3 is described. Drawing 2 is drawing illustrating the outline configuration of the optical department 17 illustrated to drawing 1 . In drawing 2 and drawing 3 , the optical department 17 is held in optical unit (package) 17B which built in the quarter-wave length plate which does not illustrate (Photodetector PD) IC17A which unified the micro prism 171 which functions as a beam splitter, the laser diode (LD) 172, the photodetector 173, and the condenser lens 174.

[0055] With reference to drawing 2 and drawing 3 , the outline of the beam-of-light locus of the optical system in optical magnetic-head equipment 1 is described. It is reflected in the inclined plane of the micro prism 171 which functions as a beam splitter, and incidence of the light injected from the laser diode 172 is carried out to a mirror 20 45 degrees. As a mirror 20 functions as an optical deflection means 45 degrees and being illustrated to drawing 1 , the laser beam which carried out incidence is deflected 45 degrees, and is injected caudad. The laser beam caudad deflected by the mirror 20 45

degrees passes 11h of light transmission holes of an arm 11, and they carry out incidence to a liquid crystal panel 21. Incidence is carried out to the objective lens 15 carried in the slider 13, it converges with an objective lens 15, and the laser beam which carried out incidence to the liquid crystal panel 21 reaches the record film 32 of MO disk 3. The laser diode 172, the 171 or 45 micro prism mirror 20 which functions as a beam splitter, the liquid crystal panel 21, and the optical-axis core of an objective lens 15 shall be in agreement. Contrary to the above, incidence of the reflected light from record film 32 is carried out to the inclined plane of an objective lens 15 and the micro prism 171 which functions as a beam splitter via the 21 or 45 liquid crystal panel mirror 20, it is condensed with a condenser lens 174 and incidence of it is carried out to a photodetector 173. An objective lens 15, the 21 or 45 liquid crystal panel mirror 20, the micro prism 171, the condenser lens 174, and the optical-axis core of a photodetector 173 shall be in agreement.

[0056] It is a well-known quadrisection photodetector, and it is inputted into the control unit 4 which gives detail with reference to drawing 8, and is used for generation of servo signals, such as a tracking error signal, a focal error signal, and a RF signal, and a photodetector 173 uses these signals also for control of the liquid crystal panel 21 which mentions a detail later.

[0057] In addition, if the optical department 17 is arranged so that the inclined plane of the micro prism 171 which functions as a beam splitter may be positioned in the location applicable to the 45-degree mirror 20 illustrated to drawing 1 and drawing 3 using the optical department 17 illustrated to drawing 2, a mirror 20 can be deleted 45 degrees. That is, the 45-degree mirrors 20 as an optical deflection means are not the requirements for a configuration indispensable for the gestalt of this operation. However, in the following description, the case where a mirror 20 is formed 45 degrees is described like an illustration.

[0058] The optical department 17 in the gestalt of this operation has illustrated about the case where finite light is used. However, a collimator can be inserted in the latter part of LD172, and parallel light can also be generated. However, it illustrates about the case where finite light is used in the following description.

[0059] Amendment of the wave aberration by the liquid crystal panel 21 is described. The optical system of the above-mentioned optical magnetic-head equipment 1 is influenced of various kinds of wave aberration. The class of such wave aberration is described below. First, it originates in the alignment error at the time of manufacture, and wave aberration happens from a height gap of an objective lens 15, a gap of the optical-axis core of the objective lens 15 from an optical-axis core, etc. (such wave aberration is hereafter called 1st wave aberration). Subsequently, aberration becomes large toward the optical-axis core of the spherical aberration of an objective lens 15 etc. to the objective lens 15 to the periphery section (such wave aberration is hereafter called 2nd wave aberration). Furthermore, the wave aberration by the location gap when carrying out chucking of MO disk 3 may also happen (such wave aberration is hereafter called 3rd wave aberration). Moreover, it originates in temperature and/or humidity and wave aberration happens from a height gap of an objective lens 15, a gap of the optical-axis core of the objective lens 15 from an optical-axis core, etc. (such wave aberration is hereafter called 4th wave aberration). When calling it wave aberration on these specifications, what named generically the wave aberration mentioned above is meant.

[0060] Among such wave aberration, when chucking of MO disk 3 is loaded and carried out, the 1st - the 3rd wave aberration scan a basic pit, and they can compute them by the ability to make servo signals detected by the photodetector 173, such as a focal error signal and a tracking error signal, able to contrast with the servo signal of criteria. Therefore, when using exchangeable MO disk 3, whenever it loads and carries out chucking of MO disk 3, the 1st and 2nd wave aberration can be computed by the ability to scan a basic pit, and it can memorize in the memory section of the liquid crystal control section 61 of the control unit 4 later mentioned with reference to drawing 7.

[0061] When same MO disk 3 is being used on the same conditions, the 1st - the 3rd wave aberration can be treated as constant value. However, since the value of wave aberration changes with amounts of defocusing as the continuous line of drawing 4 illustrated, in the gestalt of this operation, a focal error signal etc. computes the occasional wave aberration in the liquid crystal control section 61 using a servo

signal.

[0062] The axis of abscissa of drawing 4 shows the amount of defocusing, and the amount actual value (rms) of wave aberration is shown on an axis of ordinate. In drawing 4, a continuous line shows the characteristic curve shown by the quadratic curve when not amending wave aberration, without using a liquid crystal panel 21, and a broken line shows the characteristic curve at the time of amending wave aberration using a liquid crystal panel 21 similarly shown by the quadratic curve.

[0063] The 4th wave aberration resulting from a temperature change, humidity, etc. is changed comparatively gently according to change of temperature and/or humidity. Therefore, the 3rd wave aberration can be expressed as a function of temperature and humidity. As the calculation amendment approach of the wave aberration, as illustrated to drawing 7, the wave aberration of drawing 4 can be computed by the ability to arrange a temperature sensor 63 and a humidity sensor (not shown) in optical magnetic-head equipment 1, input reading of these sensors in the liquid crystal control section 61, and calculate within the liquid crystal control section 61 by the ability making these readings into a function, for example. However, amendment of the wave aberration of drawing 4 can need a temperature sensor 63 and a humidity sensor, a configuration can become complicated, and the amendment can also be abbreviated to calculation of the wave aberration resulting from these on conditions with little a temperature change and humidity.

[0064] When computed before actuation of optical recording and a regenerative apparatus by the approach which wave aberration mentioned above, the wave aberration can be amended using a liquid crystal panel 21. The rate of optical refraction which the direction of liquid crystal changes according to the electrical potential difference to which a liquid crystal panel 21 is impressed, consequently passes a liquid crystal panel 21 changes.

[0065] The function as a wave aberration amendment means of such a liquid crystal panel 21 is considered further.

[0066] Drawing 5 (A) is the basic cross-section block diagram of a liquid crystal panel 21, and drawing 5 (B) is drawing showing the property. Illustrating [ for example, ] to drawing 5 (A), the liquid crystal panel 5 of a nematic mold has the orientation film 52 and 56 for specifying the direction of a molecule of liquid crystal, the liquid crystal 51 enclosed among these orientation film 52 and 56, transparent electrodes 53 and 57, and substrates 54 and 58. If an electrical potential difference is impressed to the transparent electrode film 53 and 57 of a liquid crystal panel 5, since the direction of the molecule of liquid crystal 51 changes, change of a refractive index will take place as a result. That is, as the liquid crystal panel 5 was illustrated to drawing 5 (B) according to the electrical potential difference to impress, the refractive index of liquid crystal 51 changes. If the part which changes linearly like the A section especially is used, according to applied voltage, a refractive index can be changed linearly. In order to control change of a refractive index easily and correctly, the liquid crystal panel 5 in which a property with the gently-sloping inclination of the A section is shown is desirable. Therefore, also in the gestalt of this operation, the big part of refractive-index change of the A section is utilized.

[0067] Drawing 6 (A) A liquid crystal panel 21 is described with reference to - (D). Drawing 6 (A) is the outline block diagram of the liquid crystal panel constituted in consideration of the property of the liquid crystal panel 5 described with reference to drawing 4 (A) and (B) as a liquid crystal panel 21 of the optical magnetic-head equipment 1 illustrated to drawing 1. Drawing 6 (B) is a graph which shows that the refractive index was changed for every field of a liquid crystal panel 21. The liquid crystal panel 21 in the gestalt of this operation consists of four fields divided in the shape of a concentric circle. That is, the liquid crystal panel 21 is divided into the center circle field 211, the inside ring domain 212, the central ring domain 213, and the outside ring domain 214. Centering on the optical axis which the core of the center circle field 211 described with reference to drawing 3, it is in agreement.

[0068] The basic structure of these fields is having structure illustrated to drawing 5 (A), an electrical potential difference is impressed independently of two transparent electrodes of each field which counter, and as illustrated to drawing 6 (B), the liquid crystal panel 21 is constituted so that a refractive index may change for every field according to the electrical potential difference to impress. In order to divide and operate a liquid crystal panel 21 to such a field, it constitutes so that the transparent electrode

57 of one side of the liquid crystal panel 5 illustrated to drawing 5 (A), for example, a transparent electrode, may be divided into drawing 6 (A) like an illustration, it may be manufactured to it and an electrical potential difference different, respectively can impress it between one transparent electrode 53 and each field of the transparent electrode 57 divided in the shape of a concentric circle.

[0069] When the amount of wave aberration which was illustrated to drawing 6 (C) by which the amount of wave aberration (phase contrast) was shown on the axis of ordinate by setting an axis of abscissa as the pupil radius  $r$  of an objective lens 15 exists, When the refractive-index difference of a liquid crystal panel 21 was changed according to radial so that this amount of wave aberration might be offset as illustrated to drawing 6 (B), as the laser beam which passes a liquid crystal panel 21 and passes along an objective lens 15 was illustrated to drawing 6 (D), the amount of wave aberration decreases. However, the instantiation illustrated to drawing 6 (D) shows that the remainder (the amount of residual wave aberration) of some amount of wave aberration exists without offsetting the amount of wave aberration completely.

[0070] If wave aberration is amended using a liquid crystal panel 21, the amendment property result of a refractive index as shown with the broken line of drawing 4 will be obtained, for example. Thus, if wave aberration is appropriately amended using a liquid crystal panel 21, the value will become remarkably small and the precision of the same quadratic curve of focal control will improve. Wave aberration is changed by low frequency, so that it can be mostly said to be DC component as compared with fluctuation of a focus. That is, since wave aberration is changed comparatively gently, it computes the actual value and amends the wave aberration shown as actual value with the liquid crystal panel 21.

[0071] Thus, a liquid crystal panel 21 changes a refractive index in the shape of a concentric circle, and may change phase distribution. That is, a liquid crystal panel 21 is used as a wave aberration amendment means to amend spatially the amount of wave aberration in the optical system of optical magnetic-head equipment 1 (in concentric circle-like space), or to compensate phase contrast spatially (in concentric circle-like space). The method of division of the field of a liquid crystal panel 21, a number, and area size are determined according to the magnitude and the configuration of the pupil radial (the amount of defocusing) phase contrast of an objective lens 15.

[0072] The control unit 4 described with reference to drawing 7 performs control of the applied voltage to each field 211 of a liquid crystal panel 21, i.e., a center circle field, the inside ring domain 212, the central ring domain 213, and the outside ring domain 214.

[0073] The control unit 4 illustrated to control unit drawing 7 has the interfaces 52 and 53 which perform a signal transfer with the magnet mechanical component 41, the laser mechanical component 42, the detection signal-processing section 43, the tracking servo controller 44, the recovery pretreatment section 46, the recovery section 47, a system controller 48, the modulation section 49, the memory controller 50, RAM51, and the host computer of the high order which is not illustrated. A control unit 4 has the liquid crystal control section 61 and the liquid crystal mechanical component 62 further.

[0074] The magnet mechanical component 41 drives the field modulation coil 14 according to the signal from the modulation section 49 at the time of the writing of the data to MO disk 3. The laser mechanical component 42 drives the laser diode 172 in the optical department 17 (LD) according to data writing or data read-out. The detection signal-processing section 43 receives the detecting signal from the photodetector 173 which is a quadrisection detector, and calculates a tracking error signal, a focal error signal, a RF signal, etc. The tracking servo controller 44 drives a voice coil motor 19 with reference to the tracking error signal detected in the detection signal-processing section 43, and performs tracking control of the optical magnetic head 1.

[0075] Focal control is described. Since the slider 13 of optical magnetic-head equipment 1 surfaces by the wind pressure by rotation of MO disk 3 as illustrated to drawing 1, the distance of the objective lens 15 to the front face of MO disk 3 is usually maintained by the predetermined value  $d$ . Namely, theoretically, focal control is attained by the flying head and, as for the gestalt of this operation, focal control assumes the case of being unnecessary, in a control unit 4. Therefore, the element related to focal control is not contained in the control unit 4 of the gestalt of the 1st operation. However, wave

aberration amendment described below is performed.

[0076] Tracking control is described. The tracking servo controller 44 inputs the tracking error signal computed in the detection signal-processing section 43, and the voice coil motor 19 which is a tracking actuator is driven so that a tracking error may be set to 0. By it, it rotates in the field where the arm 11 attached in the shaft 18 free [ rotation ] is parallel to the field of MO disk 3 (in or direction perpendicular to space). Rotation of such an arm 11 can perform tracking control to the track of MO disk 3. The 17 or 45 optical department mirror 20 and liquid crystal panel 21 which were carried in the arm 11, the slider 13 carried in the suspension 12, and the field modulation coil 14 and objective lens 15 which were carried in the slider 13 move in one. In the gestalt of this operation, unlike the advanced technology mentioned above, the distance of an objective lens 15 and the optical department 17 is short, and since the optical fiber etc. is unnecessary, optical coupling effectiveness is high and it is reliable.

[0077] A system controller 48 controls the memory controller 50, the modulation section 49, the recovery pretreatment section 46 and the recovery section 47, the tracking servo controller 44, the liquid crystal control section 61, etc. according to read-out or writing, when read-out or a write-in command is received from external devices, such as a host computer, through an interface 53. At the time of the writing of data, the data which should be written in MO disk 3 are recorded on the memory controller 50 via an interface 52, and it is once saved at RAM51. Conversely, at the time of read-out of data, the data which read from MO disk 3 and were reproduced in a photodetector 173, the detection signal-processing section 43, the recovery pretreatment section 46, and the recovery section 47 are temporarily saved through the memory controller 50 at RAM51, and it is sent out to the host computer of a high order through an interface 52.

[0078] At the time of data writing, the modulation section 49 is driven from a system controller 48, and performs modulation processing (coding processing) of addition of an error correction code (ECC), a run length limit (RLL), NRZI or NRZ, etc., etc. about the data read from RAM51.

[0079] The recovery pretreatment section 46 has the A/D-conversion circuit, the equalizer circuit, the phase lock loop (PLL), the Viterbi decoder circuit, etc. The recovery pretreatment section 46 operates at the time of data read-out. An A/D-conversion circuit changes into a digital signal the analog signal calculated in the detection signal-processing section 43. An equalizer circuit equalizes the signal changed into the digital signal. PLL reproduces a clock signal. The Viterbi decoder circuit decodes the signal currently recorded on MO disk 3 from the RF signal using the reproduced clock. The recovery pretreatment section 46 has the address decoder, and computes the address of the optical magnetic head 1 from the signal from the detection signal-processing section 43 again.

[0080] The recovery section 47 operates at the time of data read-out, carries out processing contrary to the processing modulated in the modulation section 49 to the data to which it restored in the recovery section 47, reproduces the original data, and sends them out to the memory controller 50.

[0081] The liquid crystal control section 61 is a part which has a microcomputer, the data-processing function which builds in memory, and a memory storage function. A height gap of the objective lens 15 resulting from the alignment error at the time of (1) manufacture mentioned above, (2) The 3rd wave aberration to which aberration becomes large toward the optical-axis core of the variation in the chucking condition of MO disk 3, the spherical aberration of the (3) objective lens 15, etc. to the objective lens 15 to the periphery section, (4) The 2nd wave aberration which originates in temperature and/or humidity and happens from a height gap of an objective lens 15, a gap of the optical-axis core of the objective lens 15 from an optical-axis core, etc. is amended using a liquid crystal panel 21.

[0082] The liquid crystal mechanical component 62 is constituted independently possible [ impression of an electrical potential difference ] between the transparent electrodes of the center circle field 211 of the liquid crystal panel 21 illustrated to drawing 5 (A), the inside ring domain 212, the central ring domain 213, and the outside ring domain 214.

[0083] The liquid crystal control section 61 generates the signal which amends wave aberration which was illustrated to drawing 6 (B) for every fields of these of a liquid crystal panel 21, and sends it out to the liquid crystal mechanical component 62. Therefore, when chucking of MO disk 3 is carried out as mentioned above for example, the liquid crystal control section 61 scans the pit of criteria, measures the

1st - the 3rd wave aberration, and memorizes them in the memory in the liquid crystal control section 61. In this instantiation, in order to simplify a configuration, the temperature sensor 63 and humidity sensor which were mentioned above are not formed, and amendment of the 4th wave aberration by these is not performed.

[0084] The liquid crystal control section 61 computes the amount of amendments which amends the wave aberration memorized by memory the whole field of a liquid crystal panel 21 in actual timing of operation according to the amount of defocusing using a focal error signal, using the servo signal computed from the photodetector 173. The liquid crystal mechanical component 62 impresses the electrical potential difference according to the amount of amendments from the liquid crystal control section 61 between the transparent electrodes of each field of a liquid crystal panel 21. Consequently, it changes according to the electrical potential difference to which the refractive index of the liquid crystal of each field of a liquid crystal panel 21 was impressed, and wave aberration is amended as illustrated to drawing 6 (D).

[0085] As the wave aberration mentioned above was mentioned above, an abrupt change does not carry out but is changed comparatively slowly. Therefore, what is necessary is just to perform the above-mentioned processing by the liquid crystal control section 61 with a comparatively long period, for example, period extent of 1 minute.

[0086] In the block diagram 1, drawing 2, and drawing 7 of an electronic circuitry of optical magnetic-head equipment 1, the laser diode (LD) 172 and the photodetector 173 are carried in the interior of the optical department 17 carried in the arm 11 of optical magnetic-head equipment 1, and the detection signal-processing section 43 can also be built in the optical department 17, and can generate servo signals, such as a focal error signal, a tracking error signal, and a RF signal, in the optical department 17. The liquid crystal control section 61 and the liquid crystal mechanical component 62 are included in the interior of the optical department 17, and the liquid crystal control section 61 can input, the servo signal, for example, the focal error signal, from the detection signal-processing section 43, and can drive a liquid crystal panel 21 in optical magnetic-head equipment 1. In this case, optical magnetic-head equipment 1 has a wave aberration amendment means. On the contrary, it can also prepare in the fixed part to which the optical magnetic-head equipment 1 together with the recovery pretreatment section 46, a system controller 48, etc. left the liquid crystal control section 61 and the liquid crystal mechanical component 62. Similarly, the tracking servo controller 44 can also be built into the interior of the optical department 17, and the optical magnetic-head equipment 1 together with the recovery pretreatment section 46, a system controller 48, etc. can also be formed in the left fixed part. When the liquid crystal control section 61, the liquid crystal mechanical component 62, and the tracking servo controller 44 are built into the optical department 17, wave aberration amendment and tracking control can be realized in optical magnetic-head equipment 1.

[0087] Actuation of the magneto-optic recording and regenerative apparatus of the gestalt of book operation of a magneto-optic recording and a regenerative apparatus of operation is described. MO disk 3 is rotating at the predetermined rotational frequency with the spindle motor which is not illustrated. By rotation of MO disk 3, only a distance predetermined [ the front face of MO disk 3 to ] in the slider 13 of optical magnetic-head equipment 1 surfaces.

[0088] When a data write request is emitted by the system controller 48 from a host computer through an interface 53, a system controller 48 operates the memory controller 50, and is made to record on the data RAM 51 which is transmitted through an interface 52 and which should be written in. In parallel to this actuation, the recovery section 47 controls the tracking servo controller 44 and the modulation section 49. The detail is given below.

[0089] A system controller 48 drives the tracking servo controller 44, and positions the optical magnetic head 1 to the address with which MO disk 3 was specified (tracking control is carried out). It moves in the direction in which all (equipped) the components 20 carried in the arm 11 driven with a voice coil motor 19, i.e., a 17 or 45 optical department mirror, a liquid crystal panel 21, a suspension 12, a slider 13, the field modulation coil 14, and an objective lens 15 are parallel to the front face of MO disk 3 in one at the time of this tracking actuation.

[0090] If it will be in an on-truck condition, a system controller 48 will send out the data which were recorded on RAM51 and which should be written in in the modulation section 49 through the memory controller 50. The modulation section 49 performs various modulation processings mentioned above to the inputted data which should be written in. The magnet mechanical component 41 drives the field modulation coil 14 based on the modulation result in the modulation section 49. Consequently, the field modulation coil 14 carried in the slider 13 with which only the predetermined distance  $d$  has surfaced from MO disk 3 modulates the field of the record film 32 of lower MO disk 3. The laser mechanical component 42 drives the laser diode 172 in the optical department 17 based on the modulation result in the modulation section 49.

[0091] Incidence of the laser beam light injected toward the micro prism 171 from the laser diode 172 illustrated to drawing 2 and drawing 3 is carried out to an objective lens 15 through the 171 or 45 micro prism mirror 20 and a liquid crystal panel 21, it converges there, the record film 32 of MO disk 3 irradiates, and the writing of data is performed.

[0092] When the read-out demand of data is sent out to a system controller 48 from a host computer through an interface 53, a system controller 48 drives the tracking servo controller 44, and the optical magnetic head 1 makes the address with which MO disk 3 was specified position it. A system controller 48 drives the recovery section 47, and the recovery pretreatment section 46 makes the data of the origin which is not modulated or encoded recover it from the data currently recorded on decoded MO disk 3 in an on-truck condition. The data to which it restored are sent out to a host computer through an interface 52, if it is once recorded on RAM51 via the memory controller 50 and the data of the specified quantity are stored.

[0093] Wave aberration is amended by the liquid crystal control section 61 and the liquid crystal mechanical component 62, and the liquid crystal panel 21 in the above actuation.

[0094] Since the objective lens 15 and the field modulation coil 14 which were carried in the slider 13 will be appropriately risen to surface from MO disk 3 if the optical magnetic-head equipment 1 of the gestalt of this operation is used as mentioned above, focal control becomes unnecessary fundamentally. Therefore, the time amount spent on focal control is unnecessary, and responsibility is high.

[0095] Especially according to the gestalt of the 1st operation of this invention, wave aberration is amended appropriately and the exact focal control of it is attained.

[0096] Since it is located in right above [ of the objective lens 15 carried in the slider 13 ], the die length of optical system of the optical department 17 which has held the micro prism 171 of the gestalt of this operation, the laser diode (LD) 172, and the photodetector 173 is also short, and it ends, and its optical joint effectiveness is high and it can manufacture optical magnetic head equipment 1 small.

[0097] Furthermore, since these move in one at the time of tracking control, the gestalt of this operation has conquered the problem accompanying alienation with the optical department in the conventional technique mentioned above, and an objective lens and a field modulation coil.

[0098] Since the arm 11 instead of a slider 13 on which the optical department 17 surfaces are equipped, the optical department 17 does not affect focal control. That is, in the optical magnetic-head equipment 1 of the gestalt of this operation, there is little constraint to the weight of the optical department 17, constraint, a dimension, etc. Therefore, the configuration of the optical department 17 can be made into arbitration.

[0099] Since the optical magnetic head 1 is made very small, it is applicable as the optical magnetic heads, such as small magneto-optic disks, such as the latest MO disk 5 inches or less.

[0100] Deformation modes, such as the optical magnetic-head equipment 1 of the gestalt of the 1st operation and a control unit 4, are stated to the deformation gestalt pan of the gestalt of the 1st operation.

[0101] Although the optical department 17 in which the 1st of the gestalt of the 1st operation carried out deformation mode \*\*\*\* illustrated about the case where finite light is used, as a gestalt of this operation, you can make it located in the latter part of a laser diode (LD) 172, it can be made parallel light, and a collimator lens can also be made into the optical department 17 using parallel light.

[0102] In the gestalt of the operation in which the 2nd of the gestalt of the 1st operation carried out

deformation mode \*\*\*\*, although the case where rotated an arm 11 with a voice coil motor 19, and tracking control was performed was described, it can also be made a configuration which performs the translatory movement which a voice coil motor or other actuators are used [ translatory movement ], and moved forward or retreats an arm 11 to shaft orientations, and performs tracking control. Therefore, the drive approach of an arm 11 is not limited for this invention to the rotation approach. As a configuration which performs such translatory movement, various well-known techniques, such as a configuration performed with one shaft and a configuration performed by biaxial, are applicable.

[0103] In the gestalt of the operation in which the 3rd of the gestalt of the 1st operation carried out deformation mode \*\*\*\*, although the example which carried the field modulation coil 14 in the optical department 17 is shown, according to a rotation record medium and a recording method, other field impression means can be carried suitably.

[0104] Although the case where a liquid crystal panel 21 was used was described as a gestalt of suitable operation of a wave aberration amendment means, if it is optical equipment which can change a refractive index, according to applied voltage, the optical equipment of not only the liquid crystal panel 21 but others is applicable in the gestalt of operation mentioned above, like a liquid crystal panel 21.

[0105] In addition to the wave aberration amendment described in the gestalt of the 1st operation mentioned above with reference to drawing 8 and drawing 9 as a gestalt of the 2nd operation of gestalt this invention of the 2nd operation, the optical head equipment, and the optical recording and the regenerative apparatus which tune fluctuation of the flying height of a flying head finely, and perform focal control to a precision are described.

[0106] Drawing 8 is the cross-section block diagram of the optical magnetic-head equipment as a gestalt of the 2nd operation of the optical head equipment of this invention. Drawing 8 also shows the cross-section configuration of the optical MAG (MO) disk as a gestalt of operation of an optical recording medium. Drawing 9 is the block diagram of the control unit which carries out drive control of the optical magnetic-head equipment illustrated to drawing 8. If the optical magnetic-head equipment illustrated to drawing 8, an MO disk, and the control unit illustrated to drawing 9 are combined, it will become the magneto-optic recording and regenerative apparatus of the gestalt of the 2nd operation of the optical recording and the regenerative apparatus of this invention.

[0107] The difference of structure with optical magnetic-head equipment 1A illustrated to drawing 8 and the optical magnetic-head equipment 1 illustrated to drawing 1 is described. Optical magnetic-head equipment 1A of drawing 8 is replaced with the arm 11 illustrated to drawing 1, and arm 11A which consists of thick section 11a and closing-in section 11b is used for it. The piezo-electric element 16 as an electrostrictive actuator was attached in the tip lower part of closing-in section 11b, and the piezo-electric element 16 is equipped with the optical department 17. The optical department 17 is having structure illustrated to drawing 2, and the piezo-electric element 16 is equipped with it so that the inclined plane of the micro prism 171 which functions as a beam splitter may face to an objective lens 15. Although it is the same as the structure of drawing 1 that the slider 13 is attached at the tip of a suspension (pendant member) 12 that only the predetermined distance d can be risen to surface from MO disk 3, with the gestalt of the 1st operation, the liquid crystal panel 21 is attached in the upper part of an objective lens 15 at the slider 13. From the principle expressed in the gestalt of the 1st operation, the liquid crystal panel 21 should just be located between the optical department 17 and an objective lens 15. Other configurations are the same as that of the optical magnetic-head equipment 1 fundamentally described with reference to drawing 1.

[0108] Since only the predetermined distance d surfaces from the top face of MO disk 3 with the wind pressure (or it is also called an atmospheric pressure or air bearing) of MO disk 3 which rotates with the spindle motor which does not illustrate a slider 13, this optical magnetic-head equipment 1A is also optical magnetic-head equipment of a flying head mold (head surfacing mold).

[0109] The outline of the beam-of-light locus in optical magnetic-head equipment 1A is described. The light injected from the laser diode 172 of the optical department 17 is deflected in the inclined plane of the micro prism 171 which functions as a beam splitter, goes caudad, and carries out incidence to the liquid crystal panel 21 carried in the slider 13. Incidence of the light which carried out incidence to the

liquid crystal panel 21 is carried out to the objective lens 15 carried in the slider 13, it converges and it reaches the record film 32 of MO disk 3. Contrary to the above, incidence of the reflected light from record film 32 is carried out to the inclined plane of an objective lens 15, a liquid crystal panel 21, and the micro prism 171 of the optical department 17, and it reflects the inside of the micro prism 171, and it carries out incidence to a photodetector 173. A photodetector 173 is a well-known quadrisection photodetector, is inputted into control unit 4A which gives detail with reference to drawing 9, and is used for generation of servo signals, such as a tracking error signal, a focal error signal, and a RF signal, for example.

[0110] A liquid crystal panel 21 is similarly used for amendment of wave aberration with having described the gestalt of the 1st operation. In addition to amendment of the wave aberration by the liquid crystal panel 21, in the gestalt of the 2nd operation, fine tuning of the location of the direction of a focus by the piezo-electric element 16, i.e., adjustment of the optical path length, is performed.

[0111] A piezo-electric element 16 is described. A piezo-electric element 16 is a component which starts a minute variation rate, when an electrical potential difference is impressed. Moreover, as for a piezo-electric element 16, the magnitude and the direction of a variation rate are prescribed by the sense of the crystal structure and applied voltage. In the gestalt of the 2nd operation illustrated to drawing 8, by impressing an electrical potential difference to a piezo-electric element 16, the variation rate of the piezo-electric element 16 can be carried out to the direction and perpendicular direction V-V of an illustration which intersect perpendicularly with MO disk 3, and the distance over the objective lens 15 of the optical department 17 carried in the piezo-electric element 16 can be changed. The distance between the optical department 17 and an objective lens 15 changes with the variation rates of the optical department 17. Therefore, the optical path length of the optical system of the optical magnetic-head equipment 1 containing the optical department 17 and an objective lens 15 can be changed using a piezo-electric element 16. Thus, according to the electrical potential difference impressed, a piezo-electric element 16 changes the distance between the optical department 17 and an objective lens 15 (optical path length) directly, and is used as an optical-path-length adjustment actuator which finally adjusts the optical path length of the optical system of optical magnetic-head equipment 1.

[0112] The optical-path-length controller 45 is added to the control unit 4 which illustrated control unit 4A illustrated to control unit drawing 9 to drawing 7. Other parts are the same as the control unit 4 of the gestalt of the 1st operation.

[0113] In the gestalt of the 2nd operation of tracking control, tracking control drives an arm 11 with a voice coil motor 19 almost like the gestalt of the 1st operation. In tracking control, the piezo-electric element 16 and the optical department 17 which were carried in closing-in section 11b of arm 11A, the slider 13 carried in the suspension 12 fixed to thick section 11a, and the field modulation coil 14, the objective lens 15 and liquid crystal panel 21 which were carried in the slider 13 move in one. When making a field parallel to the field of MO disk 3 rotate arm 11A (in or direction perpendicular to space) and performing tracking control, the right-hand side of thick section 11a of arm 11A is being fixed to the shaft 18 free [ rotation ], and an arm 11 is perpendicularly rotated in the range of a predetermined include angle in space with the rotation actuator 19, for example, a voice coil motor, centering on the shaft 18. Rotation of such an arm 11 can perform tracking control to the track of MO disk 3.

[0114] Since the slider 13 of focal control light magnetic-head equipment 1 surfaces by the wind pressure by rotation of MO disk 3, since the distance of the objective lens 15 to the front face of MO disk 3 is maintained by the predetermined value, the focal control section is not usually prepared in a control unit 4. However, due to change of an atmospheric pressure, although it is minute, minute fluctuation of the distance of the slider 13 to the front face of MO disk 3 is carried out considerably at high speed. Although such an amount of fluctuation is tolerance, in order to make record regeneration of a higher-density disk certain, in a microminiaturization of the latest Magnetic-Optical disk drive equipment etc., it is desirable to make it optical magnetic-head equipment 1A which does not receive such fluctuation. Then, it changes into the condition of tuning the optical path length between an objective lens 15 and the optical department 17 for fluctuation of the flying height of a slider 13 finely using a piezo-electric element 16, and not receiving fluctuation substantially. The optical-path-length

controller 45 of control unit 4A performs the control.

[0115] Only distance  $d$  has surfaced from the front face of MO disk 3 by the wind pressure accompanying rotation of MO disk 3 in a slider 13. When the focal error signal computed by the tracking servo controller 44 becomes large more than predetermined, the optical-path-length controller 45 drives a piezo-electric element 16, and adjusts the distance between an objective lens 15 and the optical department 17 (optical path length).

[0116] The amount  $\Delta$  of displacement when impressing the electrical potential difference  $V$  and electrical potential difference which are impressed to the surfacing distance  $d$  and the piezo-electric element 16 of a slider 13 as one example (namely, the amount of optical-path-length adjustments) is shown below.

[0117]

[Table 1]

Table [ ] 1  $d$ : -- case [ of near-field (NFR) ]: -- 20nm - 60nm the case of high NA (0.85-0.95) -- 0.1 micrometers - 0.4 micrometers  $V$ : several  $V$  - dozens --  $V \Delta$ : -- several micrometers - about (DC adjustment etc.) 100 micrometers

[0118] Control of the wave aberration by change of the refractive index of the liquid crystal panel 21 using the related liquid crystal control section 61 of optical-path-length adjustment and wave aberration amendment is performed a long period. Most amendments of wave aberration may be considered as DC focus fine tuning. On the other hand, control which is made to carry out the variation rate of the piezo-electric element 16 using the optical-path-length controller 45, and tunes the focal location of the optical department 17 finely since the flying height of a slider 13 is changed by the RF is performed a short period. Therefore, optical-path-length adjustment may be considered to be AC focus fine tuning. The reason called focal fine tuning is explained. Fundamental focal control is prescribed by the flying height of a flying head. Focal fine tuning means tuning the optical path length of the direction of a focus finely by the liquid crystal control section 61 and the optical-path-length controller 45 to this fundamental focal control. Therefore, the piezo-electric element 16 by the optical-path-length controller 45 is controlled at a high speed until it controls the liquid crystal panel 21 by the liquid crystal control section 61 by a certain period and the timing of control of the liquid crystal panel 21 by the following liquid crystal control section 61 reaches.

[0119] As mentioned above, if focal fine tuning using a piezo-electric element 16 is performed in addition to the wave aberration amendment using the liquid crystal panel 21 of the gestalt of the 1st operation, still highly precise focal control will be attained. Especially, the focal control in the micro optical head equipment using near-field, a far field, etc. becomes highly precise.

[0120] In addition, the description and effectiveness which were described in the gestalt of the 1st operation are the same also in the gestalt of the 2nd operation.

[0121] In the gestalt of the 1st operation of a configuration of optical magnetic-head equipment 1A, although it said that the liquid crystal control section 61 and the liquid crystal mechanical component 62 can be carried in the optical department 17 in addition to a laser diode (LD) 172, a photodetector 173, and the detection signal-processing section 43, the optical-path-length controller 45 can also be carried further. If it is made such a configuration, in an optical magnetic-head equipment 1A part, focal fine tuning will be performed and wave aberration will be amended.

[0122] although the case where a piezo-electric element 16 was used as an optical-path-length adjustment actuator was described in the gestalt of the operation in which the 1st of the gestalt of the 2nd operation carried out deformation mode \*\*\*\* -- as an optical-path-length adjustment actuator -- a piezo-electric element 16 -- replacing with -- for example, a well-known micro-actuator and electromagnetism -- an actuator etc. can be used.

[0123] drawing 10 -- as an optical-path-length adjustment actuator -- electromagnetism -- it is drawing showing the cross-section configuration of optical magnetic-head equipment 1B which carried the actuator 25 in closing-in section 11b of arm 11A. the optical department 17 -- electromagnetism -- it arranges in the location surrounded with the actuator 25 -- having -- \*\*\*\* -- electromagnetism -- by actuation of an actuator 25, the field of MO disk 3 and the optical department 17 cross at right angles,

and fluctuates. Other parts are equivalent to the above-mentioned contents described with reference to drawing 8.

[0124] as more specific instantiation of the gestalt of the operation which illustrated drawing 11 to drawing 10 -- electromagnetism -- it is drawing which expanded and illustrated the physical relationship of an actuator 25, the optical department 17, a liquid crystal panel 21, the field modulation coil 14, and an objective lens 15. Perpendicular direction V-V is made to go up and down the optical department 17 according to a suction force with the permanent magnets 25a and 25b fixed to closing-in section 11b of arm 11A, and the exclusion force by attaching Electromagnets 17a and 17b in the both sides of the optical department 17, and passing a current on these electromagnets. Distance with the objective lens 15 located in the lower part carried in the slider 13 as the result can be adjusted. In this instantiation, the thin film coil is used as a field modulation coil 14. The effectiveness mentioned above and the same effectiveness are done so also in the 2nd strange gestalt mentioned above.

[0125] The gestalt of the 3rd operation of gestalt this invention of the 3rd operation is described with reference to drawing 12 - drawing 13. Drawing 12 is the cross-section block diagram of the optical magnetic-head equipment as a gestalt of the 3rd operation of the optical head equipment of this invention. Drawing 13 is drawing showing the configuration of control unit 4B of the gestalt of the 3rd operation of this invention. If the optical magnetic-head equipment illustrated to drawing 12, an MO disk, and the control unit illustrated to drawing 13 are combined, it will become the magneto-optic recording and regenerative apparatus of the gestalt of the 3rd operation of the optical recording and the regenerative apparatus of this invention.

[0126] The optical magnetic-head equipment of drawing 12 supports optical magnetic-head equipment 1A of drawing 8. However, the variation rate of the piezo-electric element 16A carried at the tip of closing-in section 11b of arm 11A is made to carry out in optical magnetic-head equipment 1C illustrated to drawing 12 in horizontal H-H of a path which is parallel to the front face of MO disk 3, i.e., the direction of MO disk 3. Consequently, the optical department 17 with which piezo-electric element 16A was equipped is moved in the direction of tracking of MO disk 3.

[0127] As mentioned above, piezo-electric element 16A is a component which starts a minute variation rate, when an electrical potential difference is impressed. Moreover, as for piezo-electric element 16A, the magnitude and the direction of a variation rate are prescribed by the sense of the crystal structure and applied voltage. The variation rate of the piezo-electric element 16A is made to carry out in the gestalt of this operation illustrated to drawing 12 in the direction of a path which is parallel to the field of MO disk 3, i.e., the direction of MO disk 3, by impressing an electrical potential difference to piezo-electric element 16A. The amount of displacement changes according to the value of the electrical potential difference impressed to piezo-electric element 16A.

[0128] According to the variation rate of piezo-electric element 16A, the optical department 17 moves in the direction of tracking of MO disk 3. The optical-axis core of the optical department 17 and an objective lens 15 shifts, and "the optical path of the direction of tracking" changes with the horizontal variation rates of the optical department 17. Thus, the variation rate of the optical department 17 is carried out along the field of MO disk 3, and "the optical path of the direction of tracking" between an objective lens 15 and the optical department 17 can be adjusted. In this specification, it not only adjusting the optical path length of the direction of a focus, but adjusting the optical path of the direction of tracking in this way calls it optical-path-length adjustment in large semantics.

[0129] Since piezo-electric element 16A changes "the optical path of the direction of tracking" between the optical department 17 and an objective lens 15 directly and finally adjusts the optical path length of the optical system of optical magnetic-head equipment 1 according to the electrical potential difference impressed, it is large semantics and calls it an optical-path-length adjustment actuator.

[0130] Although the configuration of the optical department 17 is the same as that of what was illustrated to drawing 2, since the directions of the variation rate by the piezo-electric element 16 differ, optical magnetic-head equipment 1A of drawing 8 has also changed the sense of the optical department 17 with modification of an optical path. However, the principle of operation is the same as that of the gestalt of the 2nd operation.

[0131] Control unit 4B of drawing 13 is almost the same as control unit 4A illustrated to drawing 9 . However, it is made to respond to the directions of the variation rate of piezo-electric element 16A differing, and optical-path-length controller 45A also differs a little in the optical-path-length controller 45. However, the principle of the approach of adjusting the optical path length is the same as that of the gestalt of the 2nd operation. Although optical-path-length controller 45A adjusts "the optical path of the direction of tracking", in this specification, it is large semantics and calls it an optical-path-length controller as well as the optical-path-length controller 45 which adjusts the optical path length of the direction of a focus.

[0132] As mentioned above, in addition to amendment of wave aberration, the gestalt of the 3rd operation can also adjust the optical path length of the optical magnetic-head equipment 1 of a flying head mold. If optical magnetic-head equipment 1A illustrated to drawing 8 is compared with optical magnetic-head equipment 1C illustrated to drawing 12 , since it does not displace to perpendicular direction V-V, optical magnetic-head equipment 1C illustrated to drawing 12 is advantageous when a vertical dimension has constraint.

[0133] Deformation mode drawing 14 of the gestalt of the 3rd operation is the block diagram of optical magnetic-head equipment 1D as a deformation mode of the gestalt of the 3rd operation of this invention. Optical magnetic-head equipment 1D illustrated to drawing 14 is illustrated to drawing 11 , and is carrying out optical magnetic-head equipment 1B and a similar configuration. however, the electromagnetism as an optical-path-length adjustment actuator with which optical magnetic-head equipment 1D illustrated to drawing 15 was carried in closing-in section 11b of arm 11A -- actuator 25A makes the variation rate of the optical department 17 carry out in the direction of tracking which is parallel to the field of MO disk 3, i.e., the direction, and adjusts the optical path length of the optical system of optical magnetic-head equipment 1D. Others are the same as that of optical magnetic-head equipment 1B illustrated to drawing 10 . It is substantially [ as optical magnetic-head equipment 1C illustrated to drawing 10 ] the same to make the variation rate of the optical department 17 carry out in the direction of tracking, and to adjust the optical path length of the optical system of optical magnetic-head equipment 1D.

[0134] The gestalt of the 4th operation of this invention which referred to gestalt drawing 15 of the 4th operation is described. Drawing 15 is the cross-section block diagram of the optical magnetic-head equipment as a gestalt of the 4th operation of the optical head equipment of this invention. Like the arm 11 illustrated to drawing 1 , using the arm 11 of the thickness of homogeneity, optical magnetic-head equipment 1E illustrated to drawing 15 maintains the top face of an arm 11, and the include angle of 45 degrees at the top face near the free end of an arm 11, fixes the 45-degree mirror 20 to it, further, fixes piezo-electric element 16E to the top face of an arm 11, and is fixing the optical department 17 on this piezo-electric element 16E. The liquid crystal panel 21 is carried on the objective lens 15 at the slider 13. Other configurations are the same as that of the gestalt of the 1st operation fundamentally described with reference to drawing 1 . This optical magnetic-head equipment 1E is also the optical magnetic-head equipments 1-1D of the gestalt of the above-mentioned implementation, and optical magnetic-head equipment of the flying head mold in which slider 13 part surfaces with the wind pressure of MO disk 3 similarly.

[0135] The purpose of the liquid crystal panel 21 in the gestalt of the 4th operation is the same as that of the gestalt of the 1st operation.

[0136] Piezo-electric element 16E can move the optical department 17 to the shaft orientations (direction parallel to space) of an arm 11 along the top face of an arm 11 according to electrical-potential-difference impression. When the beam light injected from the laser diode (LD) 172 deviates on the slant face of the micro prism 171 unlike the arrangement described with reference to drawing 2 , the optical department 17 is arranged so that incidence may be carried out to a mirror 20. A mirror 20 makes the liquid crystal panel 21 and objective lens 15 of right under deflect the beam light by which incidence was carried out. Therefore, 11h of holes which beam light passes is formed in the lower part of the mirror 20 of an arm 11.

[0137] The light reflected with record film 32 passes along an objective lens 15, passes a liquid crystal

panel 21, and it carries out incidence to a mirror 20, and it is deflected towards the optical department 17 by the mirror 20, and carries out incidence to the photodetector 173 in the optical department 17.

[0138] It sets to optical magnetic-head equipment 1E illustrated to drawing 15, and the optical department 17 moves forward or goes astern toward a mirror 20 by piezo-electric element 16E. "The optical path of the direction of tracking" of an objective lens 15 and the optical department 17 changes, and the optical path length of optical magnetic-head equipment 1E changes with them. That is, also in the gestalt of the 4th operation, like the gestalt of the 3rd operation, the distance ("optical path of the direction of tracking") of an objective lens 15 and the optical department 17 is adjusted, and the focal control in the optical magnetic-head equipment of a flying head mold is complemented.

[0139] If optical magnetic-head equipment 1E of the gestalt of the 4th operation and optical magnetic-head equipment 1A of the gestalt of the 2nd operation which were illustrated to drawing 15 are compared, optical magnetic-head equipment 1E illustrated to drawing 15 is suitable, when spatial allowances are above optical magnetic-head equipment and it applies. That is, in optical magnetic-head equipment 1E, since the optical department 17 only moves horizontally on an arm 11, how to attach as compared with optical magnetic-head equipment 1A of the gestalt of the 2nd operation which moves in the vertical direction etc. is advantageous.

[0140] Also when optical magnetic-head equipment 1E of the gestalt of the 4th operation is used, control unit 4A of drawing 9 can be used. Therefore, the actuation as a magneto-optic recording and a regenerative apparatus is the same as that of the gestalt of the 2nd operation.

[0141] the electromagnetism which carries out the variation rate of the optical department 17 to horizontal H-H which replaced with piezo-electric element 16E which mentioned above the optical-path-length adjustment actuator as a deformation mode of the gestalt of the 1st operation [ 4th ] of the gestalt of the 4th operation of a deformation mode, and was illustrated to drawing 7 -- the electromagnetism equivalent to actuator 25A -- an actuator can be used.

[0142] In the gestalt of the above-mentioned implementation described with reference to the 2nd deformation mode drawing 15 of the gestalt of the 4th operation, although the optical department 17 was moved in the direction of tracking using piezo-electric element 16E the include angle of a mirror 20 is changed 45 degrees, using piezo-electric element 16E as the deformation mode, and the optical department 17 is moved substantially -- making -- \*\* -- the same effectiveness can also be done so. In that case, a mirror 20 is attached in piezo-electric element 16E 45 degrees so that a mirror 20 may rotate 45 degrees with the variation rate of piezo-electric element 16E.

[0143] The gestalt of the 5th operation of this invention is described with reference to gestalt drawing 16 of the 5th operation. Drawing 16 is the cross-section block diagram of the optical magnetic-head equipment as a gestalt of the 5th operation of the optical head equipment of this invention. Although optical magnetic-head equipment 1F illustrated to drawing 16 are carrying out the configuration similar to optical magnetic-head equipment 1D illustrated to drawing 15, piezo-electric element 16F are displaced to perpendicular direction V-V.

[0144] Since the location of the perpendicular direction of the optical department 17 changes, the optical path length of the optical system by the mirror 20 and the objective lens 15 changes with the variation rates of perpendicular direction V-V of piezo-electric element 16F. Therefore, also in optical magnetic-head equipment 1F of drawing 16, the optical path length of the optical system of optical magnetic-head equipment 1F can be adjusted using piezo-electric element 16F.

[0145] the electromagnetism which carries out the variation rate of the optical department 17 to perpendicular direction V-V which changed the optical-path-length adjustment actuator into piezo-electric element 16F mentioned above, and illustrated it to drawing 11 as a deformation mode of the gestalt of the 5th operation of a deformation mode of the gestalt of the 5th operation -- the electromagnetism equivalent to an actuator 25 -- an actuator can be used.

[0146] The gestalt of the 6th operation of this invention is described with reference to gestalt drawing 17 of the 6th operation. As a gestalt of the 6th operation of this invention, it puts and multilayers and drawing 17 is the partial perspective view of the magneto-optic recording and regenerative apparatus which met two or more sheets and a revolving shaft in the magneto-optic disk and which performs

writing of the data to two or more magneto-optic disks, and reading instantaneous. The thing of the gestalt of operation mentioned above is used for the optical magnetic head used for the magneto-optic disk of one sheet. Since the optical magnetic head mentioned above is small and lightweight, even if it uses two or more optical magnetic heads for the data writing of two or more multilayered magneto-optic disks which were illustrated to drawing 17, and read-out, the equipment configuration of the whole magneto-optic recording and regenerative apparatus can make it small. Consequently, such a magneto-optic recording and a regenerative apparatus can be manufactured to low-pricing and a light weight, and it can apply to various kinds of applications.

[0147] Although the gestalt of the operation in which the 7th operation carried out gestalt \*\*\*\* was illustrated about the case where MO disk 3 is used, as an optical rotation record medium, this invention is not restricted to application to an MO disk, but can be applied also to various optical rotation record media without magnetic action, such as an optical disk and CD. In data read-out from an optical disk, it is not necessary to carry field impression means, such as the field modulation coil 14, in a slider 13.

[0148] The optical head equipment of this invention, a control unit, and the optical recording and the regenerative apparatus that combined these are not limited to the gestalt of operation mentioned above, and its strange gestalt of the, but can take further various gestalten with the application of the technical thought of the optical head equipment of the flying head mold mentioned above.

[0149]

[Effect of the Invention] According to this invention, it is optical head equipment of a small and lightweight flying head mold, and the optical head equipment which can amend wave aberration can be offered.

[0150] According to this invention, furthermore, though it is optical head equipment of a flying head mold, in addition to amendment of the above-mentioned wave aberration, the lightweight and small optical head equipment which can adjust the optical path length of an objective lens and an optical department can be offered.

[0151] Exact focal control is possible for the optical recording and the regenerative apparatus of this invention using the optical head equipment mentioned above, it shows quick responsibility, and shows high dependability.

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[Translation done.]